

What is claimed is:

1. A process for producing a valve metal pentoxide comprising:

reacting an aqueous fluoro-solution comprising a valve metal-fluoro compound with an ammonia containing solution under controlled temperature, pH and residence time conditions to precipitate valve metal pentoxide precursor;

converting the valve metal pentoxide precursor to valve metal pentoxide; and

separating and recovering the valve metal pentoxide.

2. The process of claim 1 wherein the step of reacting the valve metal-fluoro compound with an ammonia containing solution comprises:

introducing an aqueous fluoro-solution comprising a valve metal-fluoro compound into a first vessel maintained at a first temperature;

introducing a first ammonia solution into the first vessel and mixing the first ammonia solution and the aqueous fluoro-solution to obtain a first mixture at a first pH to react the first ammonia solution and the aqueous fluoro-solution and initiate precipitation of valve metal pentoxide precursor;

transferring said first mixture into a second vessel maintained at a second temperature and a second pH to produce a second mixture and mixing to continue precipitation of valve metal pentoxide precursor.

3. The process of claim 2 wherein the step of reacting the valve metal-fluoro compound with an ammonia containing solution further comprises:

transferring said second mixture into a third vessel maintained at a third temperature and a third pH and mixing to allow precipitation of the valve metal pentoxide precursor to continue.

4. The process of claim 1 wherein the valve metal is tantalum and the process for producing tantalum pentoxide comprises:

reacting an aqueous fluoro-solution comprising a tantalum-fluoro compound with an

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ammonia containing solution under controlled temperature, pH and residence time conditions to precipitate tantalum pentoxide precursor;

converting the tantalum pentoxide precursor to tantalum pentoxide; and

separating and recovering the tantalum pentoxide.

5. The process of claim 4 wherein the step of reacting the tantalum-fluoro compound with an ammonia containing solution comprises:

introducing a first ammonia solution into the first vessel and mixing the first ammonia solution and the aqueous fluoro-solution to obtain a first mixture at a first pH and to react the first ammonia solution and the aqueous fluoro-solution and initiate precipitation of tantalum pentoxide precursor;

transferring said first mixture into a second vessel maintained at a second temperature and a second pH to produce a second mixture and mixing to continue precipitation of tantalum pentoxide precursor.

6. The process of claim 5 wherein the step of reacting the tantalum-fluoro compound with an ammonia containing solution further comprises:

transferring said second mixture into a third vessel maintained at a third temperature and a third pH and mixing to allow precipitation of the tantalum metal pentoxide precursor to continue.

7. The process of claim 6 further comprising admixing a complexing agent with the aqueous fluoro-solution.

8. The process of claim 6 wherein the converting step further comprises calcining the tantalum pentoxide precursor at a temperature greater than or equal to 790° C.

9. The process of claim 1 wherein the valve metal is niobium and the process for producing

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niobium pentoxide comprises:

reacting an aqueous fluoro-solution comprising a niobium-fluoro compound with an ammonia containing solution under controlled temperature, pH and residence time conditions to precipitate niobium pentoxide precursor;

converting the niobium pentoxide precursor to niobium pentoxide; and

separating and recovering the niobium pentoxide.

10. The process of claim 9 wherein the step of reacting the niobium-fluoro compound with an ammonia containing solution comprises:

introducing a first ammonia solution into the first vessel and mixing the first ammonia solution and the aqueous fluoro-solution to obtain a first mixture at a first pH and to react the first ammonia solution and the aqueous fluoro-solution and initiate precipitation of niobium pentoxide precursor;

transferring said first mixture into a second vessel maintained at a second temperature and a second pH to produce a second mixture and mixing to continue precipitation of niobium pentoxide precursor.

11. The process of claim 10 wherein the step of reacting the niobium-fluoro compound with an ammonia containing solution further comprises:

transferring said second mixture into a third vessel maintained at a third temperature and a third pH and mixing to allow precipitation of the niobium metal pentoxide precursor to continue.

12. The process of claim 11 further comprising admixing a complexing agent with the aqueous fluoro-solution.

13. The process of claim 11 wherein the converting step further comprises calcining the niobium pentoxide precursor at a temperature greater than or equal to 650° C.

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14. A calcined niobium pentoxide powder characterized by having:
- a BET surface area less than or equal to $3 \text{ m}^2/\text{g}$; and
 - a packed bulk density of greater than 1.8 g/cc .
15. The calcined niobium pentoxide powder of claim 14 wherein the BET surface area is less than, or equal to, $1 \text{ m}^2/\text{g}$.
16. The calcined niobium pentoxide powder of claim 14 wherein the packed bulk density is greater than or equal to 2.1 g/cc .
17. A calcined niobium pentoxide powder characterized by having:
- a BET surface area of greater than or equal to $2 \text{ m}^2/\text{g}$; and
 - a packed bulk density of less than or equal to 1.8 g/cc .
18. The calcined niobium pentoxide powder of claim 17 wherein the BET surface area is greater than or equal to $6 \text{ m}^2/\text{g}$.
19. The calcined niobium pentoxide powder of claim 17 wherein the packed bulk density is less than or equal to 1.0 g/cc .
20. A calcined tantalum pentoxide powder characterized by having:
- a BET surface area of less than or equal to $3 \text{ m}^2/\text{g}$; and
 - a packed bulk density of greater than 3.0 g/cc .
21. The calcined tantalum pentoxide powder of claim 20 wherein the BET surface area is less than or equal to $0.4 \text{ m}^2/\text{g}$.

22. The calcined tantalum pentoxide powder of claim 20 wherein the packed bulk density is greater than or equal to 4.0 g/cc.

23. A calcined tantalum pentoxide powder characterized by having:

a BET surface area of greater than or equal to 3 m²/g; and

a packed bulk density of less than or equal to 3.0 g/cc.

24. The calcined tantalum pentoxide powder of claim 23 wherein the BET surface area is greater than or equal to 11 m²/g.

25. The calcined tantalum pentoxide powder of claim 23 wherein the packed bulk density is less than or equal to 1.1 g/cc.

26. A valve metal pentoxide precursor characterized by having a line broadened d-value under x-ray analysis at:

6 ± 0.3 ;

3 ± 0.2 ; and

1.8 ± 0.1 .

27. The valve metal pentoxide precursor of claim 26 wherein the valve metal is niobium and the niobium pentoxide precursor is further characterized by having:

a BET surface area of less than or equal to 3 m²/g; and a Fluoride content of less than or equal to 500 ppm.

28. The niobium pentoxide precursor of claim 27 further characterized by having a Fluoride content of less than or equal to 150 ppm.

29. The valve metal pentoxide precursor of claim 26 wherein the valve metal is niobium and the niobium pentoxide precursor is further characterized by having:

a BET surface area of greater than $3 \text{ m}^2/\text{g}$; and a Fluoride content of less than or equal to 500 ppm.

30. The niobium pentoxide precursor of claim 29 further characterized by having a Fluoride content of less than or equal to 150 ppm.

31. The valve metal pentoxide precursor of claim 26 wherein the valve metal is tantalum and the tantalum pentoxide precursor is further characterized by having:

a BET surface area of less than or equal to $3 \text{ m}^2/\text{g}$; and a Fluoride content of less than or equal to 500 ppm.

32. The tantalum pentoxide precursor of claim 31 further characterized by having a Fluoride content of less than or equal to 150 ppm.

33. The valve metal pentoxide precursor of claim 26 wherein the valve metal is tantalum and the tantalum pentoxide precursor is further characterized by having:

a BET surface area of greater than $3 \text{ m}^2/\text{g}$; and a Fluoride content of less than or equal to 500 ppm.

34. The tantalum pentoxide precursor of claim 33 further characterized by having a Fluoride content of less than or equal to 150 ppm.

35. A process for producing valve metal pentoxides comprises:

reacting an aqueous solution comprising a valve metal compound

with a base solution under controlled temperature, pH and residence time conditions to precipitate valve metal pentoxide precursor;
converting the valve metal pentoxide precursor to valve metal pentoxide; and
separating and recovering the valve metal pentoxide.

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